

What is claimed is:

1. A piezoelectric air valve to be used for a granular material sorting machine comprising:

an air valve main body including an air pressure  
5 chamber for receiving compressed air fed from an air pressure feeding means and an air outlet extending from the air pressure chamber to the exterior,

a valve body for controlling operations to open and close a space between the air pressure chamber and the air  
10 outlet,

a piezoelectric element for generating driving force required for the operations to open and close the valve body in the form of displacements; and

at least one displacement enlarging mechanism for  
15 enlarging the displacements generated by the piezoelectric element and then applying the enlarged displacements to the valve body,

wherein the valve body, the displacement enlarging mechanism and the piezoelectric element are mechanically  
20 connected to one another, and on one hand, the operation to open the valve body is performed in accordance with the displacements generated by the piezoelectric element and subsequently enlarged by the displacement enlarging mechanism when a voltage is applied to the piezoelectric element and,  
25 on the other hand, the operation to close the

valve body is performed in accordance with resetting force of the piezoelectric element when the voltage applying to the piezoelectric element is stopped.

- 5    2.    The piezoelectric air valve according to claim 1,  
wherein the displacement enlarging mechanism comprises:

        a first hinge member, one end of which is jointed to  
the air valve main body;

        a second hinge member which is substantially parallel  
10    with respect to the first hinge member, and one end of  
which is jointed to the piezoelectric element; and

        an arm member to which the respective other ends of  
the first and second hinge members are jointed and extend-  
ing a distance longer than a distance between the first  
15    hinge member and the second hinge member,

        wherein the first hinge member, the second hinge mem-  
ber and the arm member act as the fulcrum, the point of  
power and the point of action, respectively, and the dis-  
placements generated by the piezoelectric element are  
20    enlarged  $L2/L1$  times at the point of action by virtue of  
the principle of a pry, where a distance between the ful-  
crum and the point of power is given as  $L1$  and a distance  
between the fulcrum and the point of action is given as  $L2$   
( $L1 < L2$ ).

3. The piezoelectric air valve according to claim 2,  
wherein the arm member includes the valve body at its tip  
portion in a unified state.
- 5 4. The piezoelectric air valve according to claim 2,  
wherein the second hinge member is connected to the piezo-  
electric element via a cap member.
5. The piezoelectric air valve according to claim 1,  
10 wherein a valve seat is provided between the air outlet  
and the valve body.
6. The piezoelectric air valve according to claim 1,  
wherein a pair of the displacement enlarging mechanisms  
15 are arranged symmetrically with respect to the air outlet  
as upper and lower displacement enlarging mechanisms.
7. The piezoelectric air valve according to claim 6,  
wherein the upper displacement enlarging mechanism com-  
20 prises:  
a first hinge member, one end of which is jointed to  
the air valve main body and operates as the fulcrum;  
a second hinge member, one end of which is jointed to  
the piezoelectric element in a substantially parallel re-  
25 lation with respect to the first hinge member and operates

as the point of power;

a first arm member to which the respective other ends of the first and second hinge members are jointed, the first arm member extending a distance longer than the distance between the first hinge member and the second hinge member, and the tip portion of which operates as the point of action; and

a first spring member, one end of which is jointed to the tip portion of the first arm member and the other end of which is jointed to a first part of the valve body, and wherein the lower displacement enlarging mechanism comprises:

a third hinge member, one end of which is jointed to the air valve main body and operates as the fulcrum;

a fourth hinge member, one end of which is jointed to the piezoelectric element in a substantially parallel relation with respect to the third hinge member and operates as the point of power;

a second arm member to which the respective other ends of the third and fourth hinge members are jointed, the second arm member extending a distance longer than the distance between the third hinge member and the fourth hinge member, and the tip portion of which operates as the point of action; and

a second spring member, one end of which is jointed

to the tip portion of the second arm member and the other end of which is jointed to a second part of the valve body.

5 8. The piezoelectric air valve according to claim 7, wherein the piezoelectric element is jointed between the second hinge member of the upper displacement enlarging mechanism and the fourth hinge member of the lower displacement enlarging mechanism.

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9. The piezoelectric air valve according to claim 1, wherein the piezoelectric element, the displacement enlarging mechanism and the valve body are provided in the form of a unified unit onto a base plate separated from  
15 the air valve main body, and the unit is installed in a unit installation region in the air valve main body.

10. A multiple-type piezoelectric air valve configured by transversely jointing a plurality of unit piezoelectric  
20 air valves in series, each of the unit piezoelectric air valves comprising: an air valve main body including an air pressure chamber for receiving compressed air fed from an air pressure feeding means and an air outlet extending from the air pressure chamber to the exterior; a valve  
25 body for controlling operations to open and close a space

between the air pressure chamber and the air outlet; a piezoelectric element for generating driving force in the form of displacement which is required for the operations to open and close the valve body; and a displacement enlarging mechanism for enlarging the displacements generated by the piezoelectric element and then applying the enlarged displacements to the valve body,

wherein the plurality of unit piezoelectric air valves are transversely jointed in series so that air pressure chambers are connected to one another to form a common air pressure chamber, and the respective one sides of the two outermost unit piezoelectric air valves are closed with side plates.

11. The multiple-type piezoelectric air valve according to claim 10, wherein gaskets for preventing air leakage are provided between the unit piezoelectric air valves, and between the outermost unit piezoelectric air valves and the side plates, respectively.

12. The multiple-type piezoelectric air valve according to claim 11, wherein an inlet for introducing compressed air fed from the air pressure feeding means to the compressed air chamber is formed in either one of the side plates.